Environmental Setting and Water-Quality Issues of the Mobile River Basin, Alabama, Georgia, Mississippi, and Tennessee

By Gregory C. Johnson, Robert E. Kidd, Celeste A. Journey, Humbert Zappia, and J. Brian Atkins

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FOREWORD

The U.S. Geological Survey (USGS) is committed to serve the Nation with accurate and timely scientific information that helps enhance and protect the overall quality of life, and facilitates effective management of water, biological, energy, and mineral resources. Information on the quality of the Nation's water resources is of critical interest to the USGS because it is so integrally linked to the long-term availability of water that is clean and safe for drinking and recreation and that is suitable for industry, irrigation, and habitat for fish and wildlife. Escalating population growth and increasing demands for the multiple water uses make water availability, now measured in terms of quantity and quality, even more critical to the long-term sustainability of our communities and ecosystems.

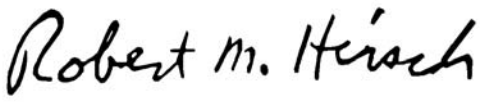
The USGS implemented the National Water-Quality Assessment (NAWQA) Program to support national, regional, and local information needs and decisions related to water-quality management and policy. Shaped by and coordinated with ongoing efforts of other Federal, State, and local agencies, the NAWQA Program is designed to answer: What is the condition of our Nation's streams and ground water? How are the conditions changing over time? How do natural features and human activities affect the quality of streams and ground water, and where are those effects most pronounced? By combining information on water chemistry, physical characteristics, stream habitat, and aquatic life, the NAWQA Program aims to provide science-based insights for current and emerging water issues. NAWQA results can contribute to informed decisions that result in practical and effective water-resource management and strategies that protect and restore water quality.

Since 1991, the NAWQA Program has implemented interdisciplinary assessments in more than 50 of the Nation's most important river basins and aquifers, referred to as Study Units. Collectively, these Study Units account for more than 60 percent of the overall water use and population served by public water supply, and are representative of the Nation's major hydrologic landscapes, priority ecological resources, and agricultural, urban, and natural sources of contamination.

Each assessment is guided by a nationally consistent study design and methods of sampling and analysis. The assessments thereby build local knowledge about water-quality issues and trends in a particular stream or aquifer while providing an understanding of how and why water quality varies regionally and nationally. The consistent, multi-scale approach helps to determine if certain types of water-quality issues are isolated or pervasive, and allows direct comparisons of how human activities and natural processes affect water quality and ecological health in the Nation's diverse geographic and environmental settings. Comprehensive assessments on pesticides, nutrients, volatile organic compounds, trace metals, and aquatic ecology are developed at the national scale through comparative analysis of the Study-Unit findings.

The USGS places high value on the communication and dissemination of credible, timely, and relevant science so that the most recent and available knowledge about water resources can be applied in management and policy decisions. We hope this NAWQA publication will provide you the needed insights and information to meet your needs, and thereby foster increased awareness and involvement in the protection and restoration of our Nation's waters.

The NAWQA Program recognizes that a national assessment by a single program cannot address all water-resource issues of interest. External coordination at all levels is critical for a fully integrated understanding of watersheds and for cost-effective management, regulation, and conservation of our Nation's water resources. The Program, therefore, depends extensively on the advice, cooperation, and information from other Federal, State, interstate, Tribal, and local agencies, non-government organizations, industry, academia, and other stakeholder groups. The assistance and suggestions of all are greatly appreciated.



Robert M. Hirsch
Associate Director for Water

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CONVERSION FACTORS, VERTICAL DATUM, AND ABBREVIATIONS

Multiply	By	To obtain
inch per year (in/yr)	2.54	centimeters per year
foot	0.3048	meter
foot per mile (ft/mi)	0.1894	meter per kilometer
mile	1.609	kilometer
cubic foot per second (ft^3/s)	448.831	gallons per minute
cubic foot per second (ft^3/s)	28.32	liters per second
cubic foot per second (ft^3/s)	0.646317	million gallons per day
acre	0.4047	hectacre
acre-foot	43,560	cubic foot
pound, avoirdupois (lb)	0.4536	kilogram
billion tons	1.016×10^{12}	kilograms
pounds per year (lbs/yr)	0.4536	kilograms per year
cubic foot per second per square mile [$(ft^3/s)/mi^2$]	0.01363	liters per second per square kilometer
square mile (mi^2)	2.590	square kilometer

Temperature in degrees Fahrenheit (^oF) can be converted to degrees Celsius (^oC) by use of the following equation:
$^oC = (^oF - 32)/ 1.8$

Sea level: In this report, “sea level” refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)—a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

Abbreviations and Acronyms

303(d) reports	List of each State’s surface waters which are classified as impaired by pollutants as required by section 303(d) of the Federal Clean Water Act of 1972
305(b) reports	State water-quality assessment documents required by section 305(b) of the Federal Clean Water Act of 1972
MLRA	Major land resource area
MSA	Metropolitan statistical area
NAWQA	National Water-Quality Assessment Program
PCB	Polychlorinated biphenyls
TRI	Toxic release inventory
U.S. EPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey

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ABSTRACT

The Mobile River Basin is one of over 50 river basins and aquifer systems being investigated as part of the U.S. Geological Survey National Water-Quality Assessment (NAWQA) Program. This basin is the sixth largest river basin in the United States, and fourth largest in terms of streamflow, encompassing parts of Alabama, Georgia, Mississippi, and Tennessee. Almost two-thirds of the 44,000-square-mile basin is located in Alabama. Extensive water resources of the Mobile River Basin are influenced by an array of natural and cultural factors. These factors impart unique and variable qualities to the streams, rivers, and aquifers providing abundant habitat to sustain the diverse aquatic life in the basin.

Data from Federal, State, and local agencies provide a description of the environmental setting of the Mobile River Basin. Environmental data include natural factors such as physiography, geology, soils, climate, hydrology, ecoregions, and aquatic ecology, and human factors such as reservoirs, land use and population change, water use, and water-quality issues. Characterization of the environmental setting is useful for understanding the physical, chemical, and biological characteristics of surface and ground water in the Mobile River Basin and the possible implications of that environmental setting for water quality.

The Mobile River Basin encompasses parts of five physiographic provinces. Fifty-six percent of the basin lies within the East Gulf section of the Coastal Plain Physiographic Province. The remaining northeastern part of the basin lies, from west to east, within the Cumberland Plateau section of the Appalachian Plateaus Physiographic Province, the Valley and Ridge Physiographic Province, the Piedmont Physiographic Province, and the Blue Ridge Physiographic Province.

Based on the 1991 land-use data, about 70 percent of the basin is forested, while agriculture, including livestock (poultry, cattle, and swine), row crops (cotton, corn, soybeans, sorghum, and wheat), and pasture land accounts for about 26 percent of the study unit. Agricultural land use is concentrated along the Black Prairie Belt district of the Coastal Plain. Urban areas account for only 3 percent of the total land use; however, the areal extent of the metropolitan statistical areas (MSA) may indicate more urban influences. The MSAs include urban areas outside of the city boundaries and can include adjacent counties. Seven MSAs are delineated in the Mobile River Basin, including Montgomery, Mobile, Tuscaloosa, Birmingham, Gadsden, Anniston, and Atlanta. The total population for the Mobile River Basin was about 3,673,100 in 1990.

State water-quality agencies have identified numerous causes and sources of water-body impairment in the Mobile River Basin. In 1996, organic enrichment, dissolved oxygen depletion, elevated nutrient concentrations, and siltation were the most frequently cited causes of impairment, affecting the greatest number of river miles. Bacteria, acidic pH, and elevated metal concentrations also were identified as causes of impairment. The sources for impairment varied among river basins, were largely a function of land use, and were attributed primarily to municipal and industrial sources, mining, and agricultural activities.

INTRODUCTION

The Mobile River Basin is the sixth largest river basin in the United States, encompassing parts of Alabama, Georgia, Mississippi, and Tennessee (fig. 1) (Lamb, 1979), and the fourth largest river basin in streamflow. Almost two-thirds of the 44,000-square-mile basin is located in Alabama. Extensive water resources of the Mobile River Basin are influenced by an array of natural and cultural factors. These factors impart unique and variable qualities to the water in streams, rivers, and aquifers, which provide abundant habitats that sustain the diverse aquatic life in the basin.

The Mobile River is formed by the confluence of two large rivers, the Tombigbee and Alabama Rivers, near Mount Vernon, Alabama. Downstream from the confluence, the Mobile River flows about 30 miles to the south before splitting into several distributaries. After flowing across a deltaic plain, these distributaries discharge to Mobile Bay (fig. 2), contributing approximately 95 percent of the freshwater inflow to the bay (Loyacano and Smith, 1979). Streamflows in these distributaries are affected cyclically by tidal processes, creating a unique and complex fluvial-estuarine system.

The Mobile River Basin is one of over 50 river basins and aquifer systems (Study Units) being studied as part of the U.S. Geological Survey National Water-Quality Assessment (NAWQA) Program. Full-scale implementation of the NAWQA Program was initiated in 1991. Information from the different study units will help Federal, State, and local agencies to make management, regulatory, and monitoring decisions to better protect, enhance, and use water resources (Hirsch and others, 1988). The NAWQA Program is designed so that the study units constitute the principal building blocks of the Program. Equivalent information from individual study units can be aggregated to assess water-quality issues on both a regional and national scale.

The long-term goals of the NAWQA Program are to (1) describe the water-quality conditions of a large representative part of the Nation's freshwater streams, rivers, and aquifers; (2) describe how the water-quality conditions are changing over time; and (3) provide a sound, scientific understanding of the major natural and human factors that affect these water-quality conditions (Leahy and others, 1990; Leahy and Wilbur, 1991). The NAWQA Program uses an integrated approach to assess water quality. Multiple lines of evidence, including physical, chemical, and biological information, are collected to determine water-quality conditions.

Design of a water-quality assessment generally considers the environmental setting of the hydrologic system because interactions between the different components of the system determine the degree of difference in water-quality conditions throughout the basin. An effective regional water-quality assessment strategy is based on the environmental setting, which incorporates many interrelated features, including physiography, geology, land use, climate, and hydrology.

Purpose and Scope

This report describes the natural and cultural factors that are believed to control or have a large-scale or regional influence on the current water quality of the Mobile River Basin. This information defines the environmental setting, which will be evaluated as the first step in designing and conducting a multidisciplinary water-quality assessment of the basin. Historical and recent information collected from Federal, State, and local agencies are used as baseline information in the report. The information also is available for future data analyses that could address specific water-quality issues of the study unit. A description of physiography, geology, soils, climate, hydrology, habitat, and aquatic biology that largely determine the natural background quality of water is included in this report. A description of the cultural features of population, and land- and water-use practices defining the human influence on water quality also is included.

Acknowledgments

The authors are grateful for the assistance provided by members of the Mobile River Basin NAWQA Liaison Committee who represent Federal, State, local, and private agencies in Alabama, Georgia, Mississippi, and Tennessee. Additionally, the authors recognize Chris Jackson, Joanne Richardson, Joseph F. Connell, and Amy C. Gill for their data compilation efforts.

ENVIRONMENTAL SETTING OF THE MOBILE RIVER BASIN

The environmental setting of the Mobile River Basin is a complex combination of natural and human

Figure 1. Location of the Mobile River Basin, Alabama, Georgia, Mississippi, and Tennessee.